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ABSTRACT

This paper discusses work on hypnotic amnesia as a paradigm of laboratory induced state-specific memory. Earlier research on sleep-specific learning and learning in varied states of consciousness is reviewed. Posthypnotic amnesia is viewed as an effective method of studying state-specific recall of episodic experiences. It is noted that highly hypnotizable subjects have little sequential recall and fail to use temporal sequencing cues, which seems to indicate that the locus of the amnesia is in the retrieval process. Work on hypnotic recall is related to the available findings about contextless recall, and directions for future research are suggested. (NG)

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Contextual and Temporal Disorganization during Posthypnotic Amnesia[1, 2]

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Although I primarily wish to discuss our work on hypnotic amnesia as a paradigm of laboratory induced state-specific memory, a brief review of our earlier studies on state-dependent learning during sleep will provide an appropriate framework for this research.

Sleep-Specific Learning

Several years ago we were able to demonstrate state-specific acquisition of meaningful behavioral responses during stage REM sleep (Evans, Gustafson, O'Connell, M. Orne, & Shor, 1965; Evans, 1972). For example, during unequivocal EEG alpha-free REM sleep we gave subjects a suggestion such as "Whenever I say the word 'itch' your nose will feel itchy until you scratch it." When the cue word "itch" was administered in a subsequent REM period, after a delay of about 90 seconds some subjects would clearly scratch their noses. When these subjects awakened the following morning, they had no awareness of the suggestions nor their responses to the cue words and did not show any behavioral, electrodermal, or EEG response to the relevant cue words. In spite of the intervening waking amnesia, when the subjects slept the following evening (or even six months later), without any other instructions, the mere repetition of the appropriate cue word, e.g., "itch," was sufficient to elicit the correct (scratching) response.

Without elaborating on the details of this phenomenon, two important points are relevant to this discussion, First, the state-specific acquisition occurred in one altered state of consciousness (i.e., sleep), and was retained over at least six months without the material being

available in the normal waking state. Second, the subjects who were capable of this sleep-specific behavior were also capable of easily experiencing another special state of consciousness: deep hypnosis. Not only can some highly hypnotizable subjects manifest sleep-specific learning, in other ongoing research we have found that they are also more likely to fall asleep quickly at night, they can easily fall asleep in a wide variety of circumstances and unusual environments, and they tend to nap more frequently than most individuals. Indeed, this work led us to hypothesize that some individuals showed a marked flexibility in controlling their psychological states, readily alternating between different states of consciousness.

Dissociative Mechanisms and State-Specific Retrieval

These results indicate that a subject who is capable of state-specific learning during sleep is also capable of experiencing other dissociative reactions, has the ability to control his entry into various altered states of consciousness, and is experienced in processing information in different states of awareness. It is our view that some kind of dissociative mechanism may be central to these state-specific effects and that this dissociation may be a function of the unavailability of certain kinds of normal retrieval strategies when attempts are made to remember episodic events in a context that is psychologically different from the state in which the acquisition occurred.

Although it is difficult to control and manipulate the dissociative or state-specific sleep-induced behavior, it is possible to induce

experimentally some of the characteristics of such dissociative states using hypnosis as a paradigm. Our more recent work has been concerned with the mechanisms of suggested posthypnotic amnesia as a method of studying state-specific recall of episodic experiences.

Parameters of Posthypnotic Amnesia

In a typical hypnosis experiment a number of suggestions of varying difficulty are presented to subjects following the induction of hypnosis. There are marked and reliable individual differences in response to these suggestions. One of these suggestions is that on the termination of hypnosis the subject will not be able to recall any of the things that happened during hypnosis. Following such a suggestion, deeply hypnotized subjects cannot recall those experiences that were just carried out during the hypnotic period. However, if hypnosis is reinduced, the same subject is then typically able to recall his previous hypnosis experiences in detail. It is in this sense that posthypnotic amnesia provides a laboratory paradigm for studying state-specific processes.

This suggested amnesia has several important characteristics, some of which are illustrated in Figure 1, which presents parametric results obtained during a typical hypnosis procedure, the Harvard Group Scale of Hypnotic Susceptibility, Form A of Shor, & E. Orne, 1962 (HGSHS:A), consisting of nine hypnotic suggestions. The slide depicts the number of experiences recalled posthypnotically by high and low hypnotizable subjects following the amnesia suggestion. Under these conditions, about 10 percent of volunteer subjects experience virtually total amnesia

for the hypnosis experiences. However, posthypnotic amnesia is not an all or none phenomenon. As can be seen in the bottom part of the slide, highly hypnotizable subjects in general recall significantly fewer suggestions than insusceptible subjects during the evaluation of amnesia.

Partial amnesia. Although some hypnotizable subjects will recall none of their hypnosis experiences, others will typically manage to remember some of their experiences, though their recall will be vague and fragmentary--and often focused on details that are trivial or irrelevant to the events they experience (Evans, Kihlstrom, & E. Orne, 1972). It is particularly these hypnotizable subjects whose amnesia is only partial who allow us to study the retrieval processes involved in posthypnotic amnesia.

Reversibility. Posthypnotic amnesia is reversible by appropriate suggestion. The top line represents total recall after the amnesia has been lifted. Note that even over such a relatively short interval subjects still forget about 30 percent of their experiences even after the amnesia has been lifted. In fact, we can only differentiate between normal forgetting and the effects of the amnesia suggestion by considering the extent to which the amnesia can be subsequently reversed and lifted by appropriate suggestion.

Disorganized retrieval. Perhaps the most important characteristic of hypnotic amnesia is derived from those subjects who are only partially amnesic. Even when they recall some experiences, hypnotizable subjects cannot put them into any meaningful order. A typical subject

may respond "Well, I did something with my left arm--no, my right arm? There was also a mosquito." However, he cannot say with conviction whether he heard the mosquito before or after he did something with his arm. We (Evans & Kihlstrom, 1973) have been documenting the accuracy of chronological recall by calculating the Spearman rank order correlation (rho score) between the order in which the subject lists those experiences that he can actually remember, and the order in which the specific suggestions were in fact administered (see Table 1). Subjects who are insusceptible to hypnosis recall the hypnotic suggestions in accurate temporal sequence, indicated by the high mean rho score, whereas those subjects who are highly susceptible to hypnosis have a much lower mean rho score, recalling their experiences in a relatively random order. This data can be shown in an alternative method (in Table 2) by classifying each individual's rho score into those that are statistically significant (indicating sequential recall) and those that are statistically insignificant (denoting random recall). It is mostly the highly hypnotizable subjects who have random recall. These differences in the sequential ordering of recalled experiences during posthypnotic amnesia in hypnotized and insusceptible subjects have been replicated in several samples.

The tendency for hypnotizable subjects to fail to use temporal sequencing cues when they are influenced by a suggestion of amnesia places the locus of the amnesia in the retrieval process itself. Because the memories can be recovered subsequently, the failure of recall during amnesia indicates that they are merely temporarily inaccessible rather than permanently irretrievable.

Posthypnotic source amnesia. This disruption of normal retrieval processes is most dramatically illustrated in a phenomenon we have called source amnesia (Evans & Thorn, 1966) where material for which there is amnesia by one method of recall may become accessible using a different method of testing recall.

During hypnosis subjects are asked some esoteric questions such as "An amethyst is a blue or purple gem stone. What color does it become when it is exposed to heat?" Most college students do not know the answer to this question, and so they are told the correct answer while they are deeply hypnotized. After several other suggestions have been given, including the usual suggestion of posthypnotic amnesia, the deeply hypnotized subject is brought out of trance and asked what he recalls. He may answer, appropriately, "Nothing," and additional prodding is usually unsuccessful in eliciting any meaningful memories. The subject is then asked "An amethyst is a blue or purple gem stone. What color does it become when it is exposed to heat?" Some subjects answer immediately, correctly, "Yellow," in spite of their protestations that they can remember nothing that happened during hypnosis. When asked how he knows this information, the subject cannot tell how he acquired it. He may rationalize: e.g., he must have learned it in a geology course, or his girl friend is interested in jewelry, etc., but he is completely incapable of recollecting that he was taught this information only a few minutes before. The information remains available in the waking state even though the context in which the information was acquired remains inaccessible.

Disrupted Retrieval and Episodic Memory

Thus, it would seem that in source amnesia, as well as in the disrupted retrieval that normally occurs during posthypnotic amnesia, the material is available to waking memory even though it cannot be located in the appropriate spatial-temporal context. The material acquired has become dissociated from its source of acquisition: it is not permanently integrated within the ongoing temporal activities occurring as the information is stored. During posthypnotic amnesia there is a temporary disorganization of memory due to the inaccessibility of retrieval cues, particularly those related to temporal sequencing, which Tulving (1972) among others, has emphasized as important in the recall of episodic as opposed to semantic memories. The locus of the state-specific effect apparently resides within the retrieval process itself.

While the evidence reviewed seemed compelling to us, at least two alternative hypotheses could account for the failure to utilize temporal retrieval cues during hypnotic amnesia, and the consequent failure of recall. The first of these hypotheses suggests that the poor recall of the hypnotized subject may be motivationally determined on the basis of his expectations that recall should be impaired following hypnosis. The second concerns the possibility that some people who happen to be hypnotizable are also relatively disorganized in everyday life and have poorer memories or less efficient memory styles. Our attempts to test both of these hypotheses have produced results that have important implications not only for understanding the nature of hypnosis, but for theories of memory concerning episodic or experiential occurrences.

Disorganized retrieval and the neglect hypothesis of amnesia. Theorists such as Barber and Sarbin have argued that hypnosis is best understood in terms of the interpersonal relationship existing between the hypnotist and his subject which results in the subject's behaving in a way that is pleasing to the hypnotist and in accord with his perceptions of how good hypnotic subjects should behave. From such a viewpoint the subject merely says he does not remember, and perhaps is even smart enough to guess that one way to forget is to consciously avoid using organizational cues as an aid to recall.

Kihlstrom (1975) recently evaluated this "amnesia by neglect" hypothesis. Four groups of about 125 subjects each were administered posthypnotic amnesia suggestions during the tape recorded HGSHS:A. After amnesia was tested in the usual fashion, a second test was given to evaluate the robustness of the amnesic phenomenon. During the second amnesia test, one group was challenged to recall more events by instructing them that in spite of their apparent amnesia if they really tried hard, they would be able to remember more of their hypnotic experiences. A second group was exhorted by a plea that they be as honest as possible in writing their recall list. Because of time, these two special groups will not be discussed further other than to point out that the challenge and exhortation instructions did not totally break down the amnesia (as measured by subsequent reversibility) nor did the disorganized retrieval (i.e., low rho scores) of the partially amnesic subjects break down. A third, control group was simply asked to once again recall their experiences as a control measure of reminiscence type effects due to repeated testing.

The crucial group for this discussion was told that they should write down their list of remembered experiences again, but this time they should try to remember all of the events in the exact chronological order in which they were administered.

Figure 2 summarizes the relevant results. Mean number of items recalled during the initial amnesia testing, experimental amnesia retesting, and during the reversibility of amnesia is plotted for high and low susceptibility subjects. The mean rho scores (measuring disorganized retrieval) are also tabulated. As we have found in previous samples, during the regular test of amnesia the differences in number of items recalled and in the rho scores significantly discriminate the susceptible from the insusceptible subjects in both groups.

It is also clear that the special challenge to recall the vague memories in exact sequence did not produce any greater increase in temporal organization than that which spontaneously occurred in the retest condition. Nor was the breakdown of amnesia in highly susceptible subjects any more extensive than for the control group susceptible subjects. The evidence from this data led us to reject a motivational neglect account of amnesia, as the significant difference in rho scores between high and low subjects still occurred even when the subjects were instructed to do their best to remember items in clear temporal order. Even under this kind of pressure the partially amnesic subjects could neither recall more, nor recall in better temporal sequence, than the retest control subjects.

Parenthetically, as would be expected from current theories of memory, those subjects who were better able to list their experiences in a better chronological order also recalled more previously forgotten events. However, we were particularly struck by several subjects in whom improved ordering was not accompanied by additional recall, and other subjects who recalled more events without being able to place them in chronological order, both in the three subgroups not stressing temporal sequence, but particularly in the group instructed to use temporal cues. The failure to observe a one-to-one relationship between organizational strategy and amount recalled using this paradigm warrants further investigation.

Poor memory: Partial recall of past experiences. In order to test the poor memory hypothesis of posthypnotic amnesia as an alternative to a state-dependent interpretation, we have been developing waking memory procedures that require the subject to use temporal sequencing as an aid to efficient recall. In one of these procedures, several clusters of three significant news events that occurred either during the immediate or distant past are presented in the waking state. For example, the subject is asked to indicate the order in which the following three events occurred:

Martin Luther King's assassination

Christian Barnard's first heart transplant

Newark and Detroit riots

In two samples we used four identical clusters of news events that occurred from about five years to about six months prior to the

experiment. Figure 3 shows the proportion of high and low hypnotizable subjects who correctly ordered the clusters of three news events. Overall, there were no significant differences in the ability of high and low susceptible subjects to recall the tasks correctly, particularly for more recent episodic news events. However, in both samples the more remote news events were recalled significantly more accurately by the highly susceptible subjects than by the relatively insusceptible subjects ($p < .05$ in both samples). This finding has particularly important implications for the study of personal memories in relation to psychotherapy. For example, hypnosis is often used to recover significant past experiences during psychotherapy using suggestion, revivification, or age regression techniques. This preliminary data, however, would suggest that the hypnotizable subject may already have a heightened normal capacity to remember meaningful past experiences. Certainly these data allow us to conclude that the postulation of a poor memory or inefficient memory style in hypnotizable subjects does not provide a reasonable alternative explanation of posthypnotic amnesia.

A model of partial memory. Relatively little research on memory for episodic experiences has been conducted; on the basis of this data we have been developing a preliminary model of partial memory for past experiences. In Figure 4 a typical cluster of items is shown. When the task is to put these items in correct chronological sequence there is obviously one correct, but five incorrect answers. It turns out, however, that the five choices that involve incorrect answers typically are not distributed randomly.

In the example, the correct order for this cluster is C, B, A. Considering the five wrong answers, two kinds of organizational strategies seem to be implicitly adopted by subjects. The first of these we have called the relational approach to organizing these experiences; the subject at least recognizes that one event preceded another, even though the third one cannot be correctly identified and placed. In the positional approach, other subjects seem to respond more intuitively, recognizing that a particular event happened recently, or a long time ago, without having any idea of its relationship to the other two events. Thus, the orders A, C, B and B, A, C are wrong answers in which the two marked events stand in the correct relational context; the order A, B, C is a wrong answer in which the subject responded by recognizing only positional information about an event. The final two wrong answers (B, C, A and C, A, B) contain both relational and positional information (see Figure 4).

In Figure 5 the relative distribution of these five kinds of wrong answers is presented for two samples. As we predicted, relational strategies are used much more frequently than the pure positional one, while the mixed strategies involving both kinds of information are used to produce incorrect answers about as frequently as the sum of the two pure strategies themselves.

The implication of this finding is that for this kind of task, we can predict the distribution of incorrect answers quite independently of the content of the news items we select: answers which reflect partial knowledge of the correct sequence of the events. Thus, our data seems

to suggest that these relational and positional effects are quite basic in the recovery of episodic personal past experiences. While we have not had time to fully tabulate the data, it turns out that the pure positional strategy is used rarely; however, it is used almost exclusively by subjects who are highly susceptible to hypnosis.

State-Specific Contextless Recall

We would consider that this tendency to use a positional strategy--that is, the ability to remember experiences isolated from the contextual framework in which the material is originally presented--is quite similar to the process involved in hypnotic source amnesia. In source amnesia the subject remembers information he learned only a few minutes before, but has no idea how he acquired this information. We believe the disorganized retrieval mechanism underlying posthypnotic amnesia represents an extension of the relatively isolated encoding of the experiences, independently of the ongoing context in which they occur, that we observe in source amnesia, and that we are also beginning to isolate in the studies of partial memory for more remote experiences. Source amnesia is dramatic because of the short interval between the acquisition of the information and its dissociation from the context in which it was acquired. The same contextual dissociation is apparent in the disorganized retrieval mechanism. However, the use of the positional strategy, in which a remote episodic experience is remembered in isolation of the other listed events, may involve the same ability to isolate a meaningful personal experience from the context in which it initially occurred. The isolation

of experience from its temporal context is also noted in psychopathological experiences such as the tip-of-the-tongue phenomenon and particularly in the development of phobic states that can be traced back to specific traumatic experiences occurring in panic states (Bagby, 1929).

The major puzzle that remains for an understanding of hypnotic amnesia concerns the mechanism whereby these organizational strategies themselves become available again at the mere presentation of a suggested cue that results in the lifting of the amnesia. If we can understand this mechanism then we may have a means available to penetrate the state-specific amnesic boundaries that occur during other learning situations, such as during sleep, drug states, special states of arousal, and in fugue states. It is precisely this kind of contextless recall, in which normal subjects can remember episodic experiences in isolation of other events, and the associated temporary inaccessibility not only of the memories themselves, but more particularly, of those organizational strategies that would normally lead to appropriate recall, that we believe is the basic mechanism underlying state-specific effects.

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Footnotes

1. Paper presented at a symposium "State-dependent learning: Implications for theories of memory" (J. D. Bransford, Chm.) at the 83rd Annual Convention of the American Psychological Association, Chicago, August 31, 1975.

2. The research reported in this report was supported in part by Grant #MH 19156-05 from the National Institute of Mental Health, Public Health Service, by Contract #DADA17-71-C-1120 from the U.S. Army Medical Research and Development Command and by the Institute for Experimental Psychiatry.

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TABLE 1

Order of Retrieving Items

(Mean rho[a]) During Posthypnotic Amnesia

	Mean rho[a]		
	High	Low	t
HGSHS:A	.65	.80	2.94*
SHSS:C	.10	.55	3.63*

[a]Rho is the rank order correlation, calculated for each S who recalls at least 3 items during amnesia, between the order in which the items were recalled and the order in which these items were administered during hypnosis.

[b]Susceptibility based on SHSS:C scores: High, 8-12; Low, 0-4.

*$p < .005$.

TABLE 2

Retrieval Order and Hypnotic Susceptibility[a]

	HGSHS:A		SHSS:C	
Retrieval	Lo	Hi	Lo	Hi
Ordered	22	8	22	3
Random	15	19	18	20
χ^2	5.68		8.61	
p<	.025		.005	

[a]Based on SHSS:C scores.

FIGURE 1

Recall of hypnosis experiences for high, medium, and low susceptibility to hypnosis following testing of suggested posthypnotic amnesia, and total recall after the amnesia has been lifted.

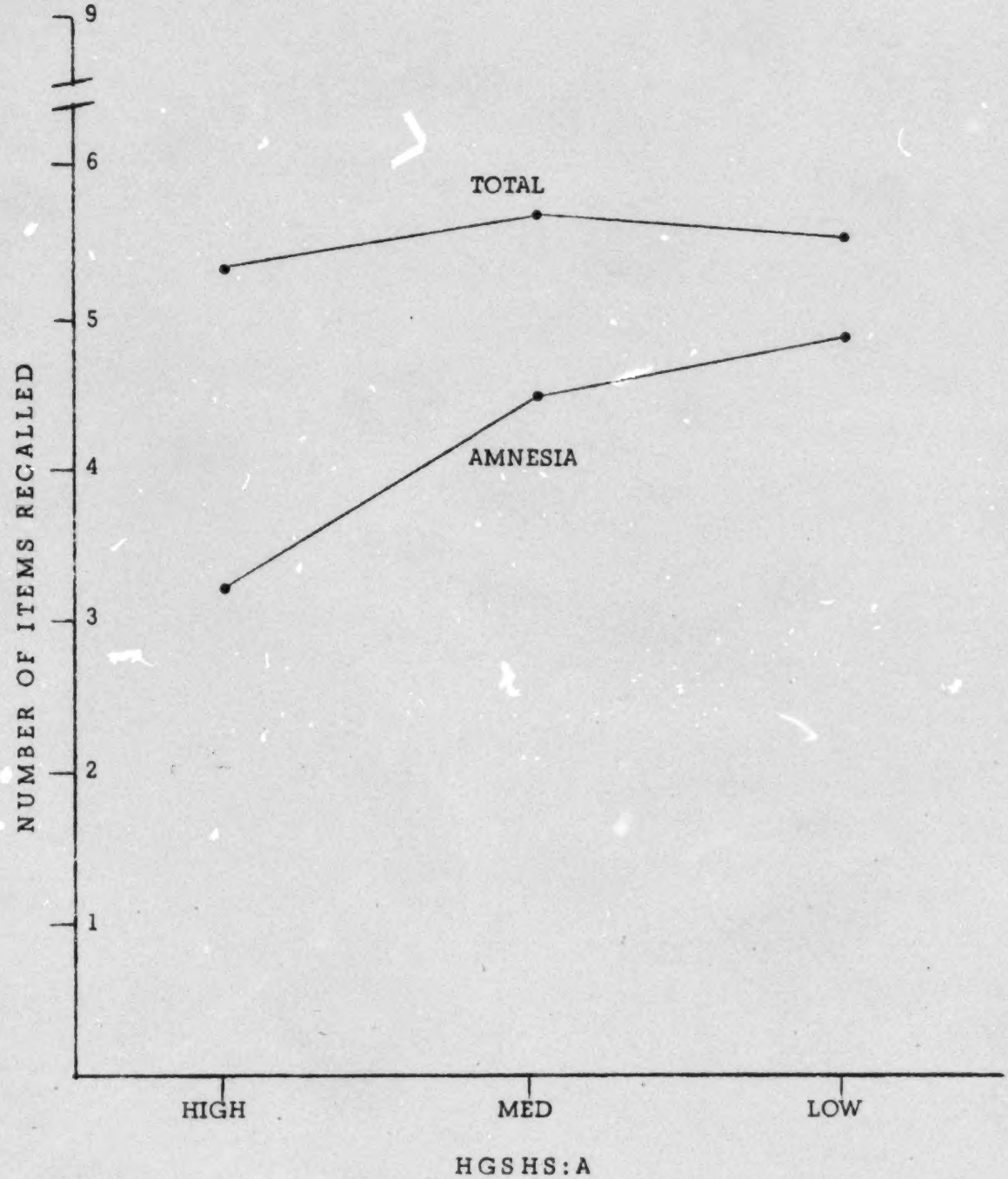

Figure 2

Mean amnesia recall and corresponding Rho Score during attempts to break amnesia.

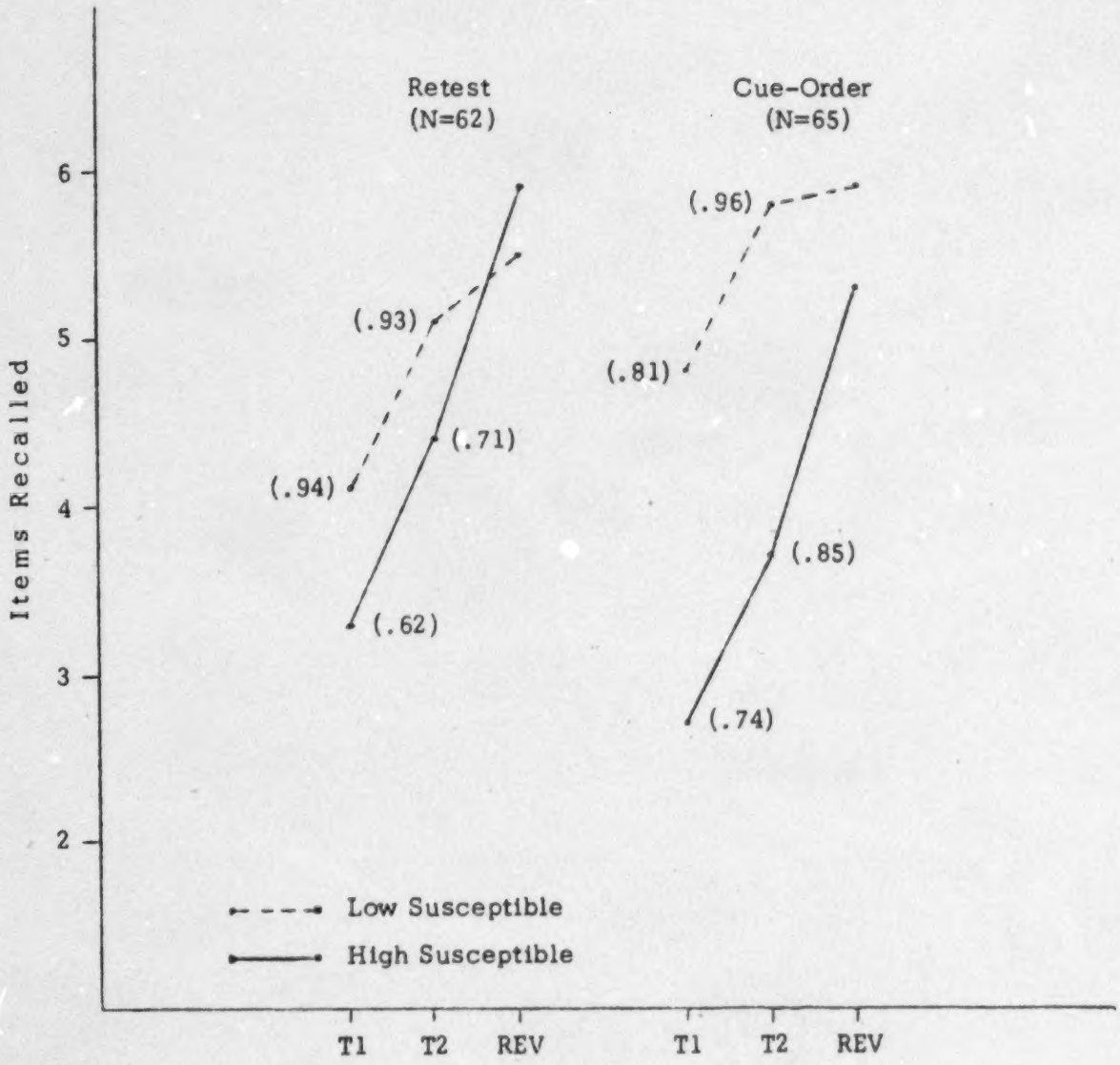

Figure 3

Hypnotizability and correct recall of cluster of significant events.

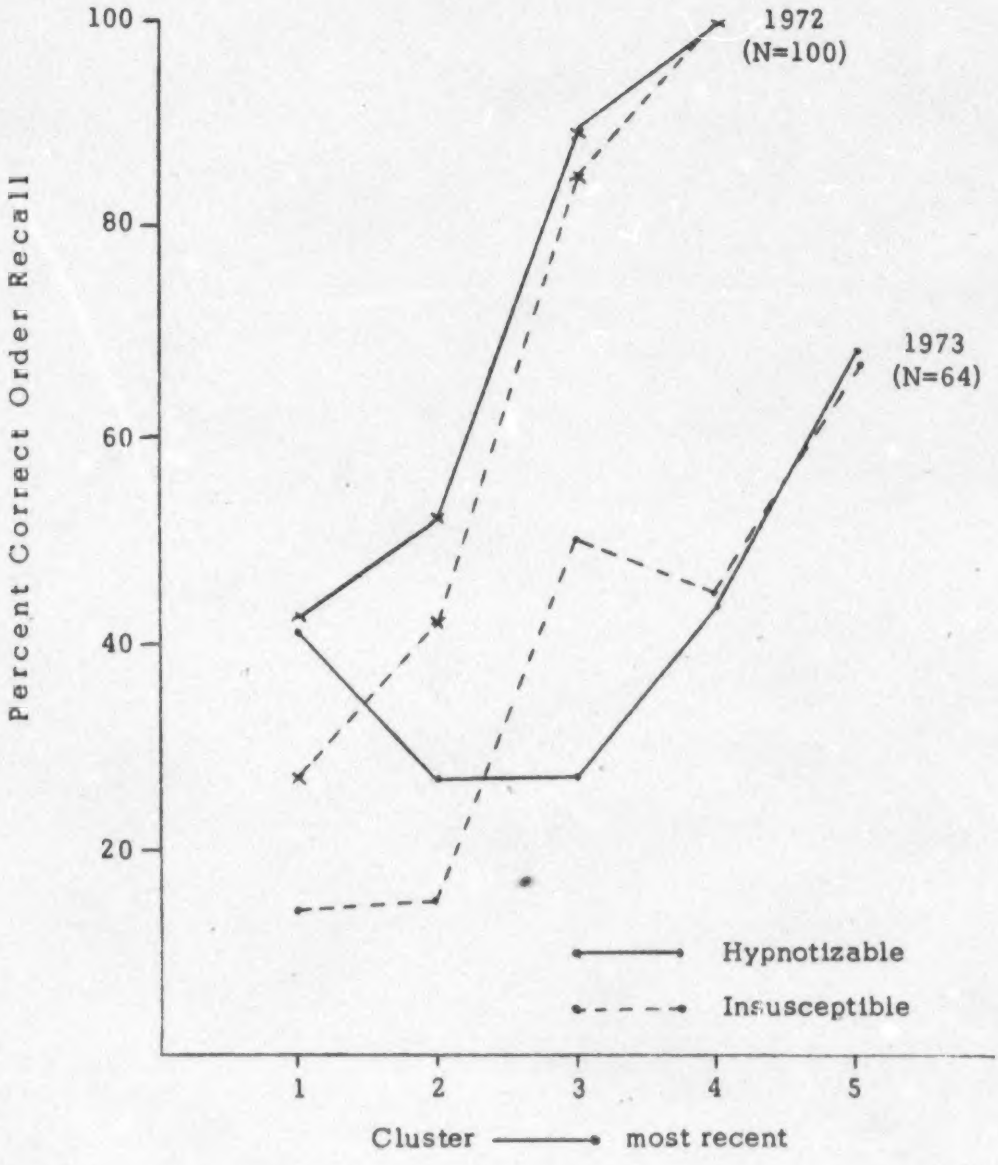

FIGURE 4

Relational (bracketed) and Positional (spotted)

Strategies during Partial Recall of Remote Experiences

A. Martin Luther King assassination [3]

B. Barnard: first heart transplant [2]

C. Newark and Detroit riots [1]

CORRECT : C B A

RELATIONAL: A [C B], [B A] C

POSITIONAL: A B C

MIXED : [C A B], B [C A]

Figure 5

Partial recall of significant past experiences: Percentage distribution of different wrong answer choices in two samples.